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Using Inexpensive Technology and Multimedia to Improve Science Education in Rural Communities of Nepal
Utiliser des technologies peu dispendieuses et le multimédia pour améliorer l'enseignement des sciences prodigué dans les communautés rurales népalaises

Sujaya Neupane

Résumé de l'article

Cet article met en lumière un projet en cours, projet facilitant l'enseignement des sciences au sein des communautés rurales de l'Ouest du Népal, par l'utilisation de technologies abordables. L'avènement de technologies peu dispendieuses et de ressources multimédia permet désormais un accès à moindre coût au matériel nécessaire à l'enseignement des sciences. Une étude préliminaire effectuée dans deux écoles du district népalais de Baglung a révélé un manque significatif de financement dans le domaine de l'enseignement des sciences. En utilisant des technologies informatiques abordables comme *Raspberry Pi* et le contenu de bibliothèques numériques à source ouverte, comme celui offert par la *Khan Academy* et Wikipédia, ce projet encourage l'utilisation de talents actuellement sous-exploités en réduisant la dépendance des communautés à l'égard de l'aide externe en éducation. Ainsi, il favorise la prise en charge et l'évolution des plates-formes éducationnelles en ligne.

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USING INEXPENSIVE TECHNOLOGY AND MULTIMEDIA TO IMPROVE SCIENCE EDUCATION IN RURAL COMMUNITIES OF NEPAL

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ABSTRACT. This article explores an ongoing project that promotes science education in rural communities of western Nepal by using affordable technology. With the advent of inexpensive technology and multimedia resources, teaching materials for science education can be accessed with a much smaller budget than was previously possible. A preliminary survey done in two schools of Baglung district in Nepal found a significant lack of funding for science education. Using affordable computing technology such as Raspberry Pi and open-source electronic library contents, including those provided by Khan Academy and Wikipedia, this project will help foster the currently underutilized talent that exists in the country by making communities less dependent on external educational aid and hence promote ownership and progress of online educational platforms.

UTILISER DES TECHNOLOGIES PEU DISPENDIEUSES ET LE MULTIMÉDIA POUR AMÉLIORER L'ENSEIGNEMENT DES SCIENCES PRODIGUÉ DANS LES COMMUNAUTÉS RURALES NÉPALAISES

RÉSUMÉ. Cet article met en lumière un projet en cours, projet facilitant l'enseignement des sciences au sein des communautés rurales de l'Ouest du Népal, par l'utilisation de technologies abordables. L'avènement de technologies peu dispendieuses et de ressources multimédia permet désormais un accès à moindre coût au matériel nécessaire à l'enseignement des sciences. Une étude préliminaire effectuée dans deux écoles du district népalais de Baglung a révélé un manque significatif de financement dans le domaine de l'enseignement des sciences. En utilisant des technologies informatiques abordables comme *Raspberry Pi* et le contenu de bibliothèques numériques à source ouverte, comme celui offert par la *Khan Academy* et Wikipédia, ce projet encourage l'utilisation de talents actuellement sous-exploités en réduisant la dépendance des communautés à l'égard de l'aide externe en éducation. Ainsi, il favorise la prise en charge et l'évolution des plates-formes éducationnelles en ligne.

Ivisited a public school in Jhimpa in 2012. Located in a remote western village of Baglung, Nepal, this school was established in the 1950s with much effort from local leaders, one of them being Jibraj Sharma. A legend I heard was that he would go out to the grazing area every morning to coax young children to leave their grazing cattle and come to the school with him so that they could get a primary education. Jibraj Sharma, formally educated in Vanaras, India, ran Jhimpa School like this for several years. He would give them sweets, making them promise that they wouldn't inform their guardians, most of whom weren't able to justify a need for education to their children. Decades later, some of the pupils are now teachers in the same school, and the others have taken up other forms of occupation than herding.

As I was growing up in Baglung and Kathmandu, my grandfather, Jibraj Sharma, was still serving his community in the different ways that he could. After high school, I moved to Canada, where I started my undergraduate degree in electrical engineering, frequently asking myself how I could use my education to benefit my community.

In Montreal, as a graduate student in neuroscience, I am looking for ways to get involved in knowledge translation, a crucial aspect of science research. After hearing an award-winning McGill graduate talk about how a microscope given to her by her father at an early age led her to a path of curiosity and observation, I was motivated to think about ways to inspire the curious young minds of my community in Montreal and in Jhimpa. I have been participating in BrainReach, a program run in Montreal by graduate students of McGill University. Every month, we spend an hour with grade nine students talking about various topics in neuroscience and doing neuroscience experiments. Such exchange between young students who are just starting to learn about science and graduate students who are delving into science research, I thought, can be fruitful to incite curiosity among young students in Nepal. Thus, I thought about running a similar workshop for kids in my native community in Jhimpa.

THE COMMUNITY

Nepal is geographically divided into three main terrains from south to north — the plains, the hills, and the mountains respectively. In the hilly regions of Nepal, villages are communities living together on the hill's slopes. Usually each hill is separated from another with natural streams of water, important sources of hydroelectricity and drinking water. Jhimpa is a small village of 200-250 households on one of such hills in mid-western Nepal. As shown in Figure 1, Jhimpa School lies at the bottom of the Jhimpa hill. Most of the villagers rely on subsistence farming, producing rice, wheat, vegetables and dairy. Being there, one gets to eat one of the healthiest and freshest diets. On the other hand, the community suffers from poor quality of education, inadequate

health care, and a decreasing number of youths, most of who have left the village in search of job prospects in Middle Eastern countries.

In April of 2012, nearly sixty years after Jibaraj Sharma had persuaded students to attend school, I, along with Sunisha Neupane and Rajan Poudel, were in Jhimpa School in a focus group discussion with students, teachers, and parents.

FIGURE 1. *Jhimpa School, located in Baglung, Nepal*

Teachers and parents held common opinions about the issues, often dwelling on the lack of infrastructure and financial stability. They wanted their pupils to be able to study science so as to pursue careers as engineers or doctors, which they believed would ensure financial stability to some extent. Their concerns were mainly with the existing educational system and tended to converge on the issue of inadequate educational funding. With little or no faith in the interim government, they unanimously favored an international donor agency's attempt to solve the issues.

Following centuries of hereditary monarchy and oligarchy since 1768, a parliamentary democratic system was practiced for the first time in 1990 (after a short stint in 1958, which was swiftly overthrown by the then King) in Nepal. Since then, the rural areas of Nepal have been potent playgrounds for political movements, armed revolution, and election campaigns, which have brought strong skepticism towards the political leaders. The same rural areas have also been labeled as underdeveloped and poor by the political leaders, foreign development agencies, and consequently by the community members themselves. Although it is true that the mountainous terrain makes it difficult to build infrastructure, ultimately bringing the communities below par in the international standards of health and economic indices, it is not fair to undermine the potential of rural Nepal by simply labeling it as poor and

backward. It seems there is a lack of a consensual definition of "development" and "poor", but still a preponderance of the notion to "develop" this "poor" community. A historically hierarchical societal structure, over two decades of unstable government, and the subscription to neoliberal notions of development have manifested in a deep-rooted inferiority complex within the community members of this young democratic country.

Talking to students was an inspiring experience. They were focused on the positive impact of education rather than on the lack of financial resources, as voiced by their elders. They wanted to become educators, scientists, journalists, doctors, teachers, and so on. It took me back to secondary school when I wanted to become a pilot. Instead of getting bogged down with the classic problem of lack of finances in schools, I wanted to focus on the aspirations of these students. What is to become of thousands of young students, full of ambitions? Is there a way for them to grow up where they can reason their way out of the vicious cycle of being victims of poor governance and dependent on international aid? I want their aspirations to mature and not fade away so that they are not creating yet another generation that seeks aid and produces "third world kids." I want to find ways to empower the young people so that this cycle breaks. Building terraces of rice paddy fields on steep hills of Nepal is a great engineering feat accomplished centuries ago. I want to encourage students to reflect on such indigenous knowledge and conceive novel ideas built on traditional as well as modern science, instead of dropping out of school with the belief that "we are underdeveloped." We would like the entire younger generation, not just a small group of academics, to be capable of questioning the existing hierarchical notion of the developed and the developing. For that, we not only need to educate young students in Nepal, but in every part of the world.

MOTIVATION AND CHALLENGES

When I returned to Montreal, I was clueless about what could be done to empower the students in my community. The subsequent steps and projects are the outcome of the thinking and discussions held with several people in this process.

Could I bring a microscope to the community and expect to produce young science enthusiasts? Wouldn't that be the same as monetary aid, donated computers, or any form of charity? I thought of my high school days and realized that studying science starts by being curious. In grade 12, it was mind boggling to me that one electron particle could simultaneously pass through two holes, similar to what was shown in Young's double slit experiment. I asked my physics teacher, G. G., about this with little capacity to understand his answer. Then, I got hold of *A Brief History of Time* where Hawking's (1988) explanation somewhat satiated my discomfort with the fact. Regardless of the level of my

understanding at that time, what had happened was that a curiosity was being developed and nurtured. Something to reinforce my curiosity helped — a book, an available teacher, and time to spend on the question. We need to find ways to wake the young minds up and not let them fall back asleep. I would have slept had I not had access to the book, access to the teacher, and the freedom of not worrying about my school uniform or my unknown future in-laws (teenage girls being married off is still a common practice in rural Nepal and is a major obstacle in girls' education). Improving science education is not just an isolated goal by itself. It is interdependent on the economic, social, familial, and personal situation of the students (Duflo, 2012).

One cannot hope to educate young people at the present age without computers. The One Laptop Per Child (OLPC) endeavor, although an attractive technological solution to weak educational infrastructure, has been likened to a postmodern colonial approach and would only add to the hierarchy of developed and the developing (Leaning, 2010). It is crucial to keep in mind Freire's (1972) approach of critical pedagogy while utilizing innovative and inexpensive technology. Critical pedagogy involves learning with utmost consciousness, critical thinking, questioning, and sometimes even changing the role of a teacher with that of a student. In order for critical pedagogy to work, students must be fearless to question. If we manage to find ways to do that, OLPC-like projects can progress in a positive way. The community members must have the ownership of any development program that is run. Unfortunately, most of the existing models of development are aid-focused and not inclusive of communities' needs, thus are unsustainable and imposing. Therefore, the goal of improving education in Jhimpa is twofold — firstly, to find a way to create an online platform for education based on critical pedagogy, and secondly, make it such that the platform is sustainable and not dependent on external aid. The former can help not only Jhimpa but also educational systems around the world. The latter can bring ownership of the educational system to the community members since ownership is crucial to break the hierarchical structure often created by external donation-based projects.

A POTENTIAL SOLUTION

Open source knowledge and technology was a promising start. Building a library could be a resourceful means to augment the slowly emerging science education in rural Nepal. A computer-based electronic library is easier to transport and less expensive than books. The concept of an e-library is not new, and there have been successful efforts to build them in Nepal (Help Nepal Network).[1] It could appear challenging to build one without support from a donor agency. However, one possible solution is Raspberry Pi, a low-cost single board computer[2] (cost: $35, weight: 45 g) designed specifically to promote education. Wikipedia, Khan Academy (KA),[3] and WOW lab[4] are few of the many freely available educational resources out of which an e-library can be built on these low cost machines.

With the technical support from a non-profit group in California, an offline package was built consisting of selected Wikipedia and KA materials, along with an operating system ready to be implemented on a Raspberry Pi computer.[5] It was an open-source package ready to be set up; I just needed to assemble it and bring it to the community. The additional costs besides the Raspberry Pi were a 32 GB storage device (SD) card ($35), a monitor ($75), and a mouse and keyboard ($5), bringing the cost of the entire setup to $150. Raspberry Pi is designed in such a way that it can also be connected to an old television set. Therefore, despite monitors being the primary cost of the project, there were less expensive possibilities. The library materials could be updated by bringing the storage device of the central server to an Internet access point in the district capital. This has been done before by a group, which used Raspberry Pi to create an offline KA library.[6] By using a bigger storage device, the central server could be extended, and a broader e-library could be created, consisting of more contents in addition to the KA videos. A similar project has been successfully implemented in schools in Ghana.[7] This project would not compete against other existing projects in Nepal or elsewhere, but build on them and create richer open-source knowledge to build low-cost, offline e-libraries in rural communities.

BACK IN THE COMMUNITY

In December 2013, the Raspberry Pi setup was installed in two of the surveyed schools, both located in the village of Jhimpa. A micro hydro plant supplied power to run the e-libraries.[8] There was a welcoming response from the teachers and the students. The students were particularly very eager to get their hands on the computer and navigate through Wikipedia. Establishing an e-library in Jhimpa has opened up sources of knowledge to students who never had access to a library before. However this change has also increased the responsibility of Jhimpa's planners and teachers to explain the value of a library to students.

The e-library has been well received in the community. While we were there in December 2013, neighboring villages heard about the e-library, which led the principals of schools in those villages to come and talk to us. They had been encouraged by the rumor of how inexpensive it was to build a library with scores of books and even videos. This is the type of reassurance that will help in developing a community with sustainable educational projects — a notion that "we can do it ourselves."

Teachers at the school were especially excited to incorporate videos in their teaching methods. Khan Academy had finally reached this remote village of Nepal and given them the opportunity to use audio and visual methods in education. Students were lining up to experience, for the first time, being in a library with a computer. One could think of the high turnout as beginner's luck, but there is also something important that we can take from it. Students

are receptive when they see something out of the ordinary. It is up to the teachers and the planners to grab this opportunity to foster the creativity and curiosity hidden inside the young minds.

With an active participation of a local leader, Shanta Raj Sharma, the school managed to get two British volunteers, high school graduates recruited by a British NGO called Project Trust, to assist in teaching English by providing accommodation and food allowance. They started their work immediately after the computers were installed in January 2014. They were in the village for a total of eight months during which the school as well as the entire village gave them a warm welcome and support. For the first time, there was a native English speaker teaching English to the kids. A great deal of positive feedback was received from the teachers and students who were learning how to use Wikipedia from the British youths. They revealed two important observations — firstly, the students and teachers were very much interested in the pictorial and video presentation of educational materials. It seemed like the KA videos did generate enthusiasm in students to learn science. According to the teachers, videos were especially useful to visualize scientific concepts. On the other hand, because the videos had not been translated to Nepali, it is not clear if the users actually understood the content. Secondly, the girls enrolled in grade five and onwards were extremely passive in terms of class participation, sports and in the usage of the library. The volunteers clearly noticed a serious lack of confidence among the female youths of Jhimpa, the brutal reality of rural Nepal. Although the new e-library and foreign volunteers created enthusiasm in the school community, empowering adolescent girls and women of Jhimpa remains a daunting challenge.

CRITIQUES AND FUTURE WORK

Inevitably, I also became that person living in Canada who feels for his community and wants to give back. I must learn from my community in order to serve, but serving out of pity is false generosity (Freire, 1972). Community development is a process where ideas get exchanged and discourses take place to work towards a common goal for uplifting every member of the community, not just a privileged few. Fund raising and donations were out of the question because such charity creates hierarchy, which enslaves the community members instead of liberating them. Liberation here means being able to think and decide freely and being fearless to take decisions and question with no sense of inferiority. However, even bringing $150 Raspberry Pi was indeed a charity at a small scale, thus conceiving a small hierarchy within the community. If I am testing an idea, its implementation will depend on the needs and activism of the community. Among the people, we want a notion of "we did this because we needed it and this idea worked" and not the notion of "Mr. X was so generous that he gave us a computer." The first notion empowers the community whereas the second notion perpetuates a sense of indebtedness.

What we have learned thus far is that it is very important to engage the community members in the process of creating something new. The affordable cost of the e-library has been crucial to not perpetuate the aforementioned hierarchy. However, it has been a challenge to shift the focus of community members from the computer to its contents. Perhaps it is natural because this was the first time the school had a computer in its study room and after the initial excitement wanes, they might focus on the content and e-technology learning tools.

The e-library resources have been originally developed in English, while people speak Nepali in local communities. This issue can possibly be resolved, firstly, by utilizing resources like KA and Wikipedia that are available to some extent in Nepali. Secondly, there have been efforts to translate KA videos in Nepali by a few volunteers.[9] However, these translation efforts, albeit growing, are not as large as those seen in more widely-spoken languages such as Spanish or Hindi. When the students use these resources presented in English along with contents translated in the language they are comfortable with, their quality of English can be expected to improve. In such a scenario the students themselves are a source of knowledge transfer, translating contents in English to Nepali as well as training their juniors. It is also the purpose of this article to bring together the Nepali diaspora studying in various institutions around the world to join hands in translating and adding to the library contents.

The next phase of the project is to replace the vulnerable desktop setup of screens and peripheral devices with even less expensive portable tablets. In such a setup a single Raspberry Pi will serve as a central server providing access to the e-library over a local network. Any device with Wi-Fi can then access the library.

Using inexpensive technology like Raspberry Pi can solve the issue of sustaining e-library equipment. It wouldn't be a burden for the schools to include the cost of such a setup in its annual budget. This could potentially solve the issue of dependency on external aid. I find that the bigger problem is to come up with ideas to encourage students to read and learn and to encourage girls to participate in learning as much as boys. Usually, economic models propose monetary incentives such as scholarships to keep students enrolled and to encourage them to excel in school. Rewards can be very helpful in training. However, when students start framing questions out of curiosity, incentives might actually limit their capabilities. Their focus should be to find an answer to their question, not to come up with a question or an answer so as to merely achieve some reward. In other words, the quest for knowledge is a character of humans that has the potential to transcend the desire of maximizing utility, the basis of most economists' arguments. So far, my effort has been to try and communicate with the students in writing. If students respond, it would be interesting to try to have them communicate with students of their age in

Canada. Exchange between young people around the world can prove to be beneficial to both parties.

Lastly, the interaction between parents and teachers cannot go unnoticed. It is true that rural communities do lack financial abundance and stable, well-remunerated teachers, which are crucial for imparting good science education. Lack of teachers in rural areas is not an isolated problem but a global one all over the world. Serious effort from the government and consciousness among people about community building is needed to solve this issue.

CONCLUSION

Perhaps, the parents living in Jhimpa in the 1950s were right about questioning the importance of primary education for their children. What was missing was a discourse on the questions they raised — what is the value of education in this year's agricultural yield? Or those raised by local scholars like Jibraj Sharma — how can Jhimpa's indigenous knowledge find its place in educational institutions? Likewise, science education can only improve in Jhimpa if the community members regularly discuss their children's education amongst themselves, with educators, government officials, and also with their children. The Raspberry Pi-based e-library is merely a tool to be utilized in a way the community deems best.

NOTES

1. See http://www.helpnepal.net/projects/completed/education/2011

2. A single board computer is a functional computer including a microprocessor, memory, input / output, and storage built on a single circuit board (https://www.raspberrypi.org/help/what-is-a-raspberry-pi/).

3. See https://www.khanacademy.org/about

4. See http://wowlab-blueprints.mcgill.ca

5. See http://rachel.worldpossible.org

6. See http://khan.mujica.org

7. See http://www.raspberrypi.org/archives/4178

8. Electricity is a requirement for any computer to run. A mere ten years ago, most of the rural communities of Nepal did not have access to electricity. After the end of civil war in 2006, the Nepal Power Development Project, a project to promote off-grid micro-hydro energy, has progressed steadily (Sovacool, Bambawale, Gippner & Dhakal, 2011), resulting in the rampant establishment of micro-hydro electricity plants in rural villages of Nepal, including Jhimpa.

9. See http://www.youtube.com/user/KhanAcademyNepali

REFERENCES

Duflo, E. (2012, May). *Human values and the design of the fight against poverty*.Retrieved from: http://www.povertyactionlab.org/sites/default/files/documents/TannerLectures_EstherDuflo_draft.pdf

Freire, P. (1972). *Pedagogy of the oppressed.* Harmondsworth, UK: Penguin.

Hawkings, S. W. (1988). *A brief history of time.* New York, USA: Bantam Books.

Leaning, M. (2010). The one laptop per child programme and the project of technology led educational development. In I. Berson & M. Berson (Eds.), *High-tech tots: Childhood in a digital world* (pp. 231-248). Charlotte, NC: Information Age Publishing.

Sovacool, B. K., Bambawale, M. J., Gippner, O., & Dhakal, S. (2011). Electrification in the Mountain Kingdom: The implications of the Nepal power development project (NPDP). *Energy for Sustainable Development, 15,* 254-265.

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